Stereoselective Asymmetric Hydrogenation Catalysts

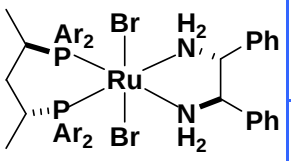
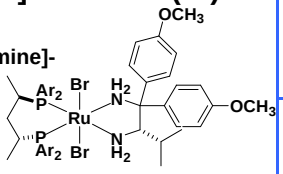
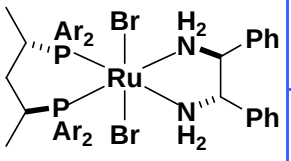
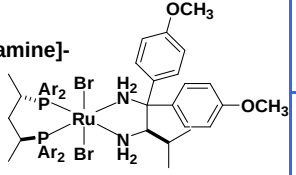
-XylSKEWPHOS Catalysts-

Kanto Reagents

We Kanto Chemical launched asymmetric hydrogenation catalysts, which were discovered by NOYORI Molecular Catalysis Project of Exploratory Research for Advanced Technology (ERATO) by Japan Science and Technology Corporation (JST) and were developed by Exploitation and Application Study supported by JST. These catalysts have both diphosphine and diamine ligands, and the catalyst performance is tunable by the choice of these chiral ligands. Chiral Ru catalysts with BINAP ligand have high reactivity and enantioselectivity for the reaction of ketones[1], but higher enantioselectivity is desirable for certain ketonic substrates.

We examined the structure of the catalysts, and the chiral Ru catalysts with 1,3-diphosphine, XylSKEWPHOS [(2,4-bis(di-3,5-xylylphosphino)pentane)] were found to have higher enantioselectivity than the prototype BINAP catalysts. Now we launch these asymmetric hydrogenation catalysts.

List of Products

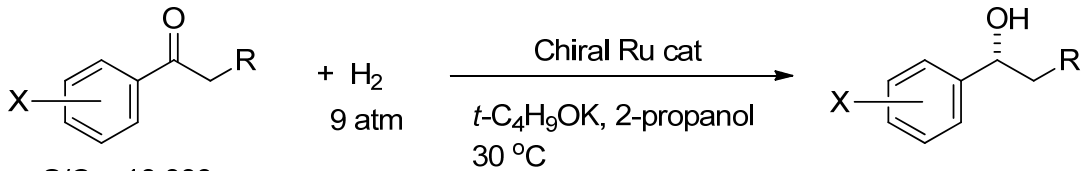
Product	Product number	Package
Dibromo[(*R*,*R*)-XylSKEWPHOS][(*R*,*R*)-DPEN]ruthenium(Ⅱ) Dibromo[(*R*,*R*)-2,4-bis(di-3',5'-xylylphosphino)pentane]-[(*R*,*R*)-1,2-diphenylethanediamine]ruthenium(Ⅱ) 【$RuBr_2$[(*R*,*R*)-xylskewphos][(*R*,*R*)-dpen]】 $C_{51}H_{62}Br_2N_2P_2Ru$ F.W : 1025.88  Ar = 3,5-$(CH_3)_2C_6H_3$	10535-68	100mg
	10535-95	500mg
Dibromo[(*R*,*R*)-XylSKEWPHOS][(*S*)-DAIPEN]ruthenium(Ⅱ) Dibromo[(*R*,*R*)-2,4-bis(di-3',5'-xylylphosphino)pentane]-[(*S*)-1,1-bis(*p*-methoxyphenyl)-2-isopropyl-1,2-ethanediamine]-ruthenium(Ⅱ) 【$RuBr_2$[(*R*,*R*)-xylskewphos][(*S*)-daipen]】 $C_{56}H_{72}Br_2N_2O_2P_2Ru$ F.W : 1128.01  Ar = 3,5-$(CH_3)_2C_6H_3$	10537-68	100mg
	10537-95	500mg
Dibromo[(*S*,*S*)-XylSKEWPHOS][(*S*,*S*)-DPEN]ruthenium(Ⅱ) Dibromo[(*S*,*S*)-2,4-bis(di-3',5'-xylylphosphino)pentane]-[(*S*,*S*)-1,2-diphenylethanediamine]ruthenium(Ⅱ) 【$RuBr_2$[(*S*,*S*)-xylskewphos][(*S*,*S*)-dpen]】 $C_{51}H_{62}Br_2N_2P_2Ru$ F.W : 1025.88  Ar = 3,5-$(CH_3)_2C_6H_3$	10536-68	100mg
	10536-95	500mg
Dibromo[(*S*,*S*)-XylSKEWPHOS][(*R*)-DAIPEN]ruthenium(Ⅱ) Dibromo[(*S*,*S*)-2,4-bis(di-3',5'-xylylphosphino)pentane]-[(*R*)-1,1-bis(*p*-methoxyphenyl)-2-isopropyl-1,2-ethanediamine]-ruthenium(Ⅱ) 【$RuBr_2$[(*S*,*S*)-xylskewphos][(*R*)-daipen]】 $C_{56}H_{72}Br_2N_2O_2P_2Ru$ F.W : 1128.01  Ar = 3,5-$(CH_3)_2C_6H_3$	10538-68	100mg
	10538-95	500mg

Asymmetric Hydrogenation

1 Hydrogenation of Aromatic Ketones

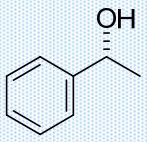
XylSKEWPHOS catalysts hydrogenate aromatic ketones effectively with high enantioselectivity to yield optically active alcohols[2]. For example, acetophenone is hydrogenated with $RuCl_2$(tolbinap)(daipen) to afford 1-phenylethanol in 91% ee and $RuBr_2$(xylskewphos)(daipen) gives 98% ee for the same substrate. Aromatic ketones with several substituents on aromatic rings are also hydrogenated efficiently to give optically active alcohols in high ee. To obtain high enantioselectivity, proper selection of the catalysts is necessary. The DPEN catalyst usually gives higher enantioselectivity than the DAIPEN catalyst for the reaction of *o*-substituted aromatic ketones. For example, *o*-chloroacetophenone is hydrogenated with the DPEN and the DAIPEN catalyst in 97% ee and 94% ee, respectively. *o*-Bromoacetophenone is hydrogenated in >99% ee with both of the DPEN and the DAIPEN catalyst. For the reaction of *m*- and *p*-substututed aromatic ketones, the DAIPEN catalyst is assumed to have better enantioselectivity than the DPEN catalyst. For example, *m*-chloro and *m*-bromoacetophenone are hydrogenated with the DAIPEN catalyst in 97% ee and 99% ee, respectively. *p*-Fluoro, *p*-chloro and *p*-bromoacetophenone are also hydrogenated with the DAIPEN catalyst in 97% ee, 97% ee and 99% ee, respectively.

Example

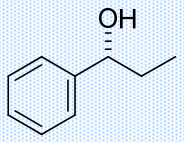


S/C = 10,000

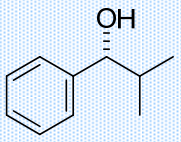
Chiral Ru cat: $RuBr_2$[(*S*,*S*)-xylskewphos][(*S*,*S*)-dpen] (cat A)
$RuBr_2$[(*S*,*S*)-xylskewphos][(*R*)-daipen] (cat B)
Conditions: ketone/Ru/*t*-C_4H_9OK = 10,000:1:40, $[ketone]_0$ = 2.0-2.5 mol/L



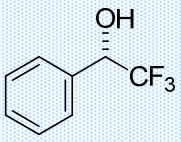
95% ee (cat A)
98% ee (cat B)



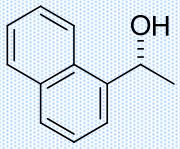
96% ee (cat A)
>99% ee (cat B)



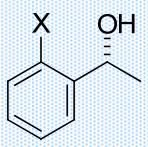
82% ee (cat A)
3% ee (cat B)



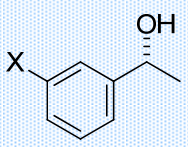
78% ee (cat B)



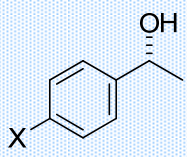
96% ee (cat A)
73% ee (cat B)



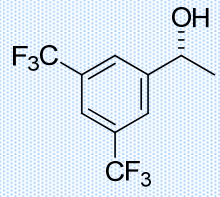
	A, % ee	B, % ee
X = CH_3	95	77
F	92	78
Cl	97	94
Br	>99	>99
CH_3O	90	40



	A, % ee	B, % ee
X = CH_3	96	96
F	95	93
Cl	94	97
Br	95	99



	A, % ee	B, % ee
X = CH_3	88	92
F	96	97
Cl	94	97
Br	97	99

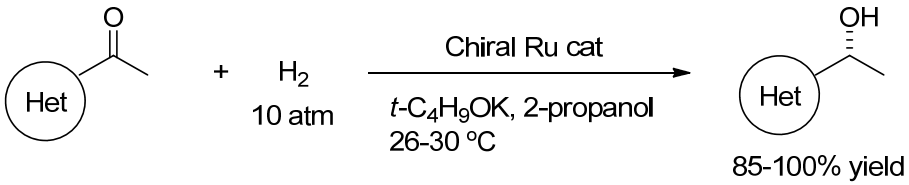


38% ee (cat A)
91% ee (cat B)

2 Hydrogenation of Heteroaromatic Ketones

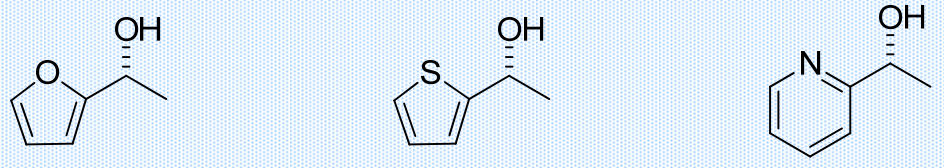
$RuCl_2$(binap)(diamine) catalysts don't have high enantioselectivity for the asymmetric hydrogenation of hetero aromatic ketones. $RuBr_2$(xylskewphos)(daipen) has higher enantioselectivity for these ketones. For example, 2-acetylfuran and 2-acetylthiophene are hydrogenated efficiently to give optically active 1-(2-furanyl)ethanol in 97% ee and 1-(2-thienyl)ethanol in 96% ee.

Example



85-100% yield

Chiral Ru cat: $RuBr_2$[(*S*,*S*)-xylskewphos][(*R*)-daipen]
Conditions: ketone/Ru/*t*-C_4H_9OK = 2,000-10,000:1:40, $[ketone]_0$ = 2.5 mol/L



S/C = 5,000
100% yield
97% ee

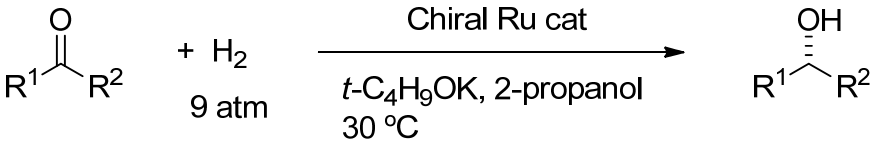
S/C = 10,000
85% yield
96% ee

S/C = 2,000
100% yield
83% ee

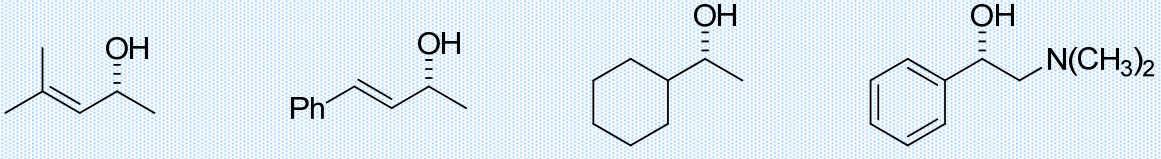
3 Hydrogenation of Other Ketones

Carbonyl compounds with conjugated or unconjugated carbon-carbon multiple bonds can be converted effectively to the corresponding unsaturated alcohols. Cyclohexyl ketone, which is a difficult substrate to obtain with high enantioselectivity, can be hydrogenated in 94% ee with this catalyst. α-*N*,*N*-Dimethylaminoacetophenone is also hydrogenated enantioselectively with 97% ee.

Example



S/C = 2,000-10,000
Chiral Ru cat: $RuBr_2$[(*S*,*S*)-xylskewphos][(*R*)-daipen]
Conditions: ketone/Ru/*t*-C_4H_9OK = 2,000-10,000:1:10-40, $[ketone]_0$ = 2.0-2.5 mol/L



91% ee

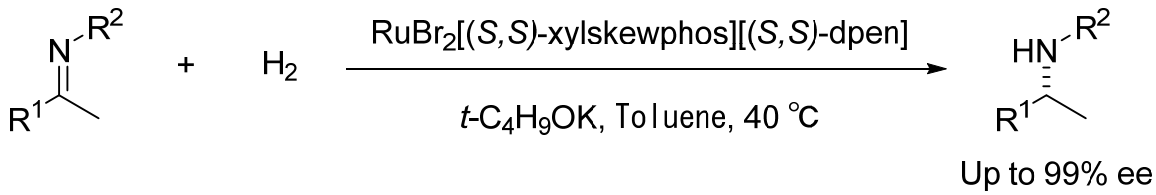
94% ee

94% ee

97% ee

4 Hydrogenation of Imines

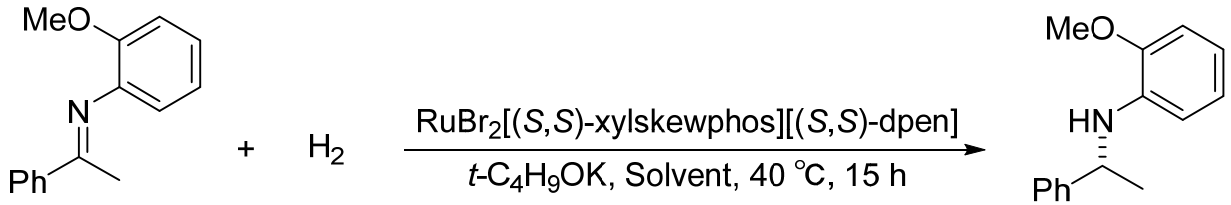
Catalytic asymmetric hydrogenation of imines is one of the most efficient and convenient method for the preparation of optically active amines. We found that $RuBr_2$(xylskewphos)(dpen) is an excellent catalyst for the asymmetric hydrogenation of imines[3] in the joint research project with Prof. Ohkuma in Hokkaido University . Various imines can be hydrogenated efficiently with this catalyst to afford the amine products in high ee's.



Up to 99% ee

Example (reaction solvent)

Reactions can be conducted in a variety of aprotic slovents such as toluene (hydrocarbon solvent) and THF (ether solvent). For example, hydrogenation of *N*-2-methoxyphenyl (OMP) acetophenone imine is completed within 15 h in various aprotic solvents in the presence of potassium *tert*-butoxide at a substrate-to-catalyst molar ratio (S/C) of 1,000 under 10 atm of hydrogen pressure, leading to the optically active phenetylamine in 99% ee.



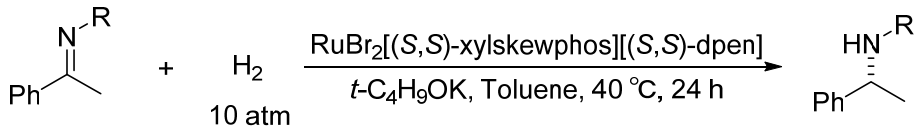
S/C = 1,000

10 atm

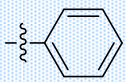
Solvent	yield (%)	ee (%)
toluene	>99	99
benzene	>99	99
THF	>99	99
MTBE	>99	99
2-propanol	<1	-
t-BuOH	<1	-

Example (scope of substrates)

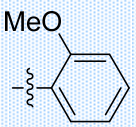
The reaction of *N*-substituted imines, where the *N*-substituent is the phenyl group, electron-donating methoxyphenyl group, or electron-withdrawing halogenated phenyl group, also proceed efficiently. For example, *N*-OMP acetophenone imine is hydrogenated at a S/C of 5,000 under 10 atm of H_2 to afford the optically active amine in 99% ee quantitatively. The methoxyphenyl group is readily deprotected to give the optically active primary amines[4]. Although the reactivity of *N*-alkyl imines is relatively low, the enantioselectivity is maintained high. For example, *N*-*n*-Bu imine is reduced at a S/C of 2,000 to afford the amine product in 97% ee with 85% yield. The ee value of product from *N*-Benzyl imines is low.



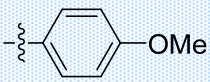
R =



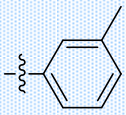
S/C = 3,000
99% yield
97% ee



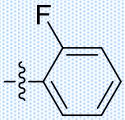
S/C = 5,000
99% yield
99% ee



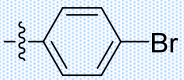
S/C = 4,500
99% yield
97% ee



S/C = 3,000
99% yield
99% ee

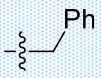


S/C = 3,000
99% yield
97% ee



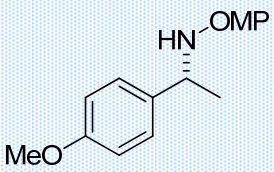
S/C = 3,000
99% yield
94% ee

S/C = 2,000
85% yield
97% ee

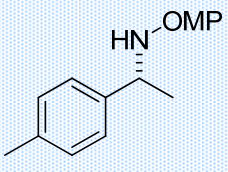


S/C = 1,000
99% yield
47% ee

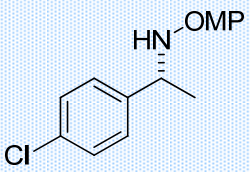
This catalyst system is applicable to a variety of *N*-aryl imines. *N*-OMP imines derived from acetophenones with an electron-donating or an electron-withdrawing group on the phenyl ring are hydrogenated at a S/C of 1,500-3,000 under 10 atm of H_2 to afford the optically active amines in up to 99% ee quantitatively. The reaction of imine with naphthalene ring, propiophenone imine and butyrophenone imine proceed efficiently. Heteroaromatic imines, such as pyridyl imines, ferrocenyl imine and α,β-unsaturated imine, are also hydrogenated in high ee's. The hydrogenation of diimine derived from 1,3-diacetylbenzene affords the diamine product with a high diastereo (*dl*:*meso* = 96:4) and high enantioselectivity (>99% ee) in 99% yield.



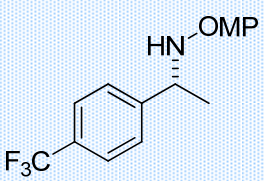
S/C = 3,000
99% yield
99% ee



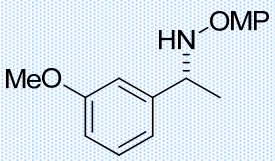
S/C = 3,000
99% yield
98% ee



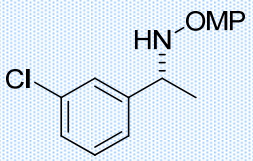
S/C = 3,000
99% yield
99% ee



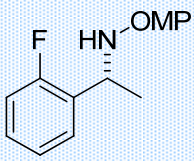
S/C = 3,000
99% yield
99% ee



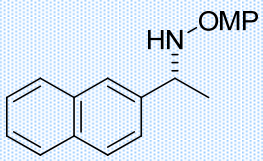
S/C = 3,000
99% yield
98% ee



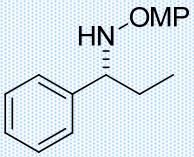
S/C = 3,000
99% yield
99% ee



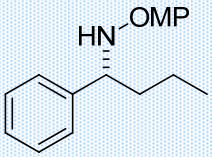
S/C = 1,500
99% yield
91% ee



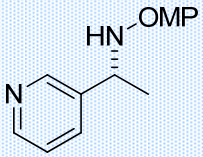
S/C = 3,000
99% yield
98% ee



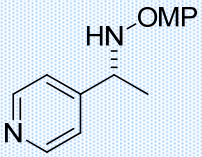
S/C = 3,000
99% yield
96% ee



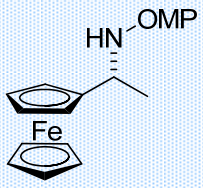
S/C = 3,000
98% yield
95% ee



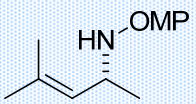
S/C = 500
99% yield
98% ee



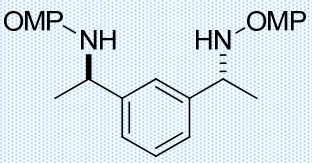
S/C = 500
98% yield
93% ee



S/C = 500
99% yield
96% ee

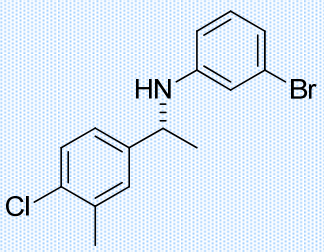


S/C = 3,000
99% yield
85% ee

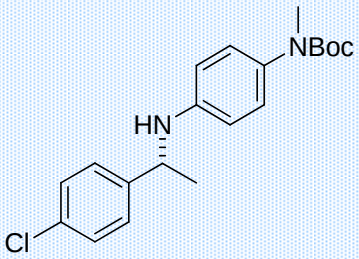


S/C = 1,000
99% yield
dl:*meso* = 96:4
>99% ee for *dl*

The *N*-substituted imine with 3-bromophenyl group or 4-Boc-aminopheny group is converted to the corresponding chiral amine in 96% ee or 93% ee, respectively. These chiral amines are enable to the synthetic intermediates of biologically active compounds[5, 6].



S/C = 2,500
99% yield
96% ee



S/C = 3,000
99% yield
93% ee

5 Procedure for Hydrogenation of Ketones

A representative procedure for the asymmetric hydrogenation of ketones using $RuBr_2$(xylskewphos)(dpen) at a S/C of 2,000 is described below.

Reaction vessel (internal volume : 100 mL)[*1]

← The ready-to-use Ruthenium(II) complex：ca. 10 mg (0.01 mmol)[*2]

(A solid substrate of ketone should be added with the Ruthenium(II) complex at this point.

Ketone substrate : 20 mmol)

↓

Purging away the inside gas of the vessel and displacing with inert gas (1 time)

← Ketone substrate : 20 mmol[*3]

← 0.01 mol/L Solution of potassium alkoxide in 2-propanol: 10 mL (0.1 mmol)[*4*5*6]

↓

Purging away the inside gas of the vessel and displacing with inert gas[*7]

↓

Replacing the inside gas of the vessel with hydrogen under stirring

(H_2 is introduced into the vessel, before being reduced to 1 atm. This procedure is repeated 3~5 times)[*8*9]

↓

Pressurizing with H_2 (10 atm)

↓

Hydrogenation (stirring, 30~60 °C)[*10*11]

↓

Isolating the alcohol product[*12]

*1: Pressure resistant glass vessel with guard jacket can be used as well as stainless steel autoclave. In case of the poor reactivity, pretreatment of vessel may be effective.

*2: Ruthenium complexes can be handled in the air. It should be kept under inert gas in a long term preservation.

*3: Because this hydrogenation is sensitive even small amount of acid, acidic impurities should be carefully removed. By the following step, washing the substrate dissolved in appropriate solvent with an aqueous KOH solution then drying over Na_2SO_4 anhydride, the substrate can be purified with an appropriate purity.

*4: Please use commercial 0.01 mol/L potassium *tert*-butoxide/2-propanol solution by our company, or prepare it from commercially available potassium *tert*-butoxide and dry 2-propanol.

*5: The strong base more than 2 equivalent of Ruthenium complex is required for the hydrogenation. Some enones might be unstable against a base may polymerize in this conditions. In that case, the concentration of the strong base should be optimized, or using a weak base such as K_2CO_3 instead of the strong base is effective.

*6: When a ketone substrate is hard to dissolve in 2-propanol, toluene or THF can be used as a cosolvent.

*7: Repeated operation as follows (remove the internal gas by vacuum line and replace with inert gas) is enable.

*8: For safety, replacing the internal gas of the vessel with H_2 should be operated in a draft-chamber (refer to the procedure in the literature: M. Kitamura, M. Tokunaga, T. Ohkuma and R. Noyori, *Org. Synth.* **1993**, *71*, 1-13).

*9: Please keep hydrogen pressure of vessel at more than 1 atm to prevent contamination by air.

*10: High speed reaction is enable with a high speed stirring.

*11: After the completion of hydrogenation, the hydrogen pressure will be decreased to the range of 4-5 atm.

*12: The residual catalyst can be removed from the product by filtration through a silica-gel pad.

Hydrogenation with more than S/C = 3,000 can be operated by the same procedure. Quantitative conversion is possible with S/C>100,000 at optimized conditions. For a detail, please consult us.

Hydrogenation under atmospheric pressure of hydrogen is possible with these Noyori type asymmetric hydrogenation catalysts. In case of the atmospheric pressure reaction, reaction at a S/C of 500-1,000 is the first recommended trial, as the reaction rate is largely decreased than the reaction under the pressure of hydrogen.

6 Procedure for Hydrogenation of Imines

A representative procedure for the asymmetric hydrogenation of *N*-OMP acetophenone imine at a S/C of 3,000 is described below using $RuBr_2$(xylskewphos)(dpen) as a catalyst.

Reaction vessel (internal volume: 100 mL)[*1]
- ← Imine substrate: 6.8 g (30 mmol)[*2]
  (a liquid substrate of imine should not be added at this point)
- ← The ready-to-use Ruthenium complex: ca. 10 mg (0.01 mol)[*3]
- ← Potassium *tert*-butoxide: 110 mg (1.0 mmol)

↓

Purging away the internal gas of the vessel and displacing with inert gas
- ← Toluene: 7.5 mL[*4]
  (A liquid substrate of imine should be added at this poiont. imine substrate: 30 mmol)

↓

Purging away the internal gas of the vessel and displacing with inert gas[*5]

↓

Replacing the internal gas of the vessel with hydrogen under stirring
(H_2 is introduced into the vessel, before being reduced to 1 atm. This procedure is repeated 3~5 times)[*6*7]

↓

Pressurizing with H_2 (10~50 atm)[*8]

↓

Hydrogenation (stirring, 30~60 °C)[*9]

↓

Isolating the amine product

*1: Stainless steel autoclave (~50 atm) and pressure resistant glass vessel(~10 atm) can be used dependent on the pressure of hydrogen.

*2: The hydrogenation of imines doesn't proceed with alcohols. Coexistence of ketones in imine substrates causes producing alcohols from the hydrogenation of ketones. Please carefully remove ketones from imine substrates.

*3: Ruthenium complexes can be handled in the air. It should be kept under inert gas in a long term preservation.

*4: A variety of aprotic solvents such as benzene, THF and MTBE can be used as a solvent.

*5: Repeated operation as follows (remove the internal gas by vacuum line and replace with inert gas) is enable.

*6: For safety, replacing the internal gas of the vessel with H_2 should be operated in a draft-chamber (refer to the procedure in the literature: M. Kitamura, M. Tokunaga, T. Ohkuma and R. Noyori, *Org. Synth.* **1993**, *71*, 1-13).

*7: Please keep hydrogen pressure of vessel at more than 1 atm to prevent contamination by air.

*8: Higher pressure of hydrogen leads to increase reaction rate as keeping enatioselectiviy high.

*9: Higher temperature leads to increase reaction rate, but enantioselectivity is slightly decreased.

[References]

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2) Novel Ruthenium complexes and preparation of alcohols with these Ruthenium catalysts. Patent 3566955 (Japan).
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[Conformation of Complexes]

$RuBr_2$(xylskewphos)(diamine) complexes present as two diastereomeric mixtures by ^{31}P-NMR analysis.

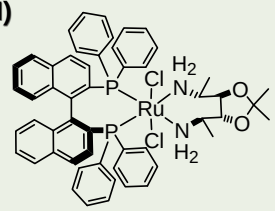
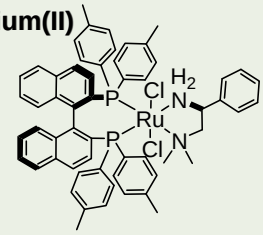
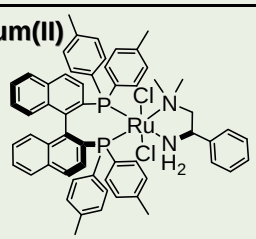
●$RuBr_2$[(*S,S*)-xylskewphos][(*S,S*)-dpen] and $RuBr_2$[(*R,R*)-xylskewphos][(*R,R*)-dpen]

^{31}P-NMR($CDCl_3$, -25 °C)δ ppm, major: 65.0 (d, J = 42.6 Hz), 41.6 (d, J = 43.6 Hz),
minor: 59.8 (d, J = 43.6 Hz), 49.0 (d, J = 48.0 Hz). major/minor = 10:9

●$RuBr_2$[(*S,S*)-xylskewphos][(*R*)-daipen] and $RuBr_2$[(*R,R*)-xylskewphos][(*S*)-daipen]

^{31}P-NMR($CDCl_3$, -25 °C)δ ppm, major: 60.0 (d, J = 48.0 Hz), 46.8 (d, J = 43.6 Hz),
minor: 60.6 (d, J = 48.0 Hz), 48.2 (d, J = 48.0 Hz). major/minor = 10:3

Related Products, Asymmetric Hydrogenation Catalysts

Product	Product number	Package
Dichloro[(*R*)-2,2´-bis(diphenylphosphino)-1,1´-binaphthyl]-[(*R*,*R*)-1,2-diphenylethanediamine]ruthenium(II) $RuCl_2$[(*R*)-binap][(*R*,*R*)-dpen]	**11404-65**	**1g**
	11404-95	**200mg**
Dichloro[(*R*)-2,2´-bis(diphenylphosphino)-1,1´-binaphthyl]-[(*S*,*S*)-1,2-diphenylethanediamine]ruthenium(II) $RuCl_2$[(*R*)-binap][(*S*,*S*)-dpen]	**11405-65**	**1g**
	11405-95	**200mg**
Dichloro[(*S*)-2,2´-bis(diphenylphosphino)-1,1´-binaphthyl]-[(*R*,*R*)-1,2-diphenylethanediamine]ruthenium(II) $RuCl_2$[(*S*)-binap][(*R*,*R*)-dpen]	**11402-65**	**1g**
	11402-95	**200mg**
Dichloro[(*S*)-2,2´-bis(diphenylphosphino)-1,1´-binaphthyl]-[(*S*,*S*)-1,2-diphenylethanediamine]ruthenium(II) $RuCl_2$[(*S*)-binap][(*S*,*S*)-dpen]	**11403-65**	**1g**
	11403-95	**200mg**
Dichloro[(*R*)-2,2´-bis(diphenylphosphino)-1,1´-binaphthyl]-[(*R*)-1,1-bis(*p*-methoxyphenyl)-2-isopropyl-1,2-ethanediamine]-ruthenium(II) $RuCl_2$[(*R*)-binap][(*R*)-daipen]	**11408-65**	**1g**
	11408-95	**200mg**
Dichloro[(*S*)-2,2´-bis(diphenylphosphino)-1,1´-binaphthyl]-[(*S*)-1,1-bis(*p*-methoxyphenyl)-2-isopropyl-1,2-ethanediamine]-ruthenium(II) $RuCl_2$[(*S*)-binap][(*S*)-daipen]	**11409-65**	**1g**
	11409-95	**200mg**
Dichloro[(*S*)-binap][(*R*)-iphan]Ruthenium(II) $RuCl_2$[(*S*)-binap][(*R*)-iphan]  ※NIPPON SODA CO., INC.	**10532-68**	**100mg**
	10532-95	**500mg**
Dichloro[(*R*)-tolbinap][(*S*)-dmapen]Ruthenium(II) $RuCl_2$[(*R*)-tolbinap][(*S*)-dmapen]  ※NIPPON SODA CO., INC.	**10533-68**	**100mg**
	10533-95	**500mg**
Dichloro[(*S*)-tolbinap][(*R*)-dmapen]Ruthenium(II) $RuCl_2$[(*S*)-tolbinap][(*R*)-dmapen]  ※NIPPON SODA CO., INC.	**10534-68**	**100mg**
	10534-95	**500mg**

Related Products, Chiral Ligands

Product Name	Product number	Package
(*R*)-(+)-2,2´-Bis(diphenylphosphino)-1,1´-binaphthyl (*R*)-(+)-BINAP	04969-35	25g
	04969-55	5g
	04969-65	1g
(*S*)-(-)-2,2´-Bis(diphenylphosphino)-1,1´-binaphthyl (*S*)-(-)-BINAP	04970-35	25g
	04970-55	5g
	04970-65	1g
rac-2,2´-Bis(diphenylphosphino)-1,1´-binaphthyl *rac*-BINAP	05069-35	25g
	05069-55	5g
	05069-65	1g
(*R*)-(+)-2,2´-Bis(di-*p*-tolylphosphino)-1,1´-binaphthyl (*R*)-(+)-Tol-BINAP	41105-55	5g
	41105-65	1g
(*S*)-(-)-2,2´-Bis(di-*p*-tolylphosphino)-1,1´-binaphthyl (*S*)-(-)-Tol-BINAP	41106-55	5g
	41106-65	1g
(*R*)-1,1-Bis(*p*-methoxyphenyl)-2-isopropyl-1,2-ethanediamine (*R*)-DAIPEN	11407-65	1g
	11407-95	200mg
(*S*)-1,1-Bis(*p*-methoxyphenyl)-2-isopropyl-1,2-ethanediamine (*S*)-DAIPEN	11406-65	1g
	11406-95	200mg
(1*R*,2*R*)-(+)-1,2-Diphenyl-1,2-ethanediamine (*R*,*R*)-DPEN	11444-35	25g
	11444-55	5g
	11444-65	1g
(1*S*,2*S*)-(-)-1,2-Diphenyl-1,2-ethanediamine (*S*,*S*)-DPEN	11445-35	25g
	11445-55	5g
	11445-65	1g

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